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SUN MICROSYSTEMS/FINNEGAN, HENDERSON LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

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HOSSAIN, TANIM M	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/787,322	FAULKNER ET AL.	
	Examiner	Art Unit	
	Tanim Hossain	2145	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-60* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-60* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *See Continuation Sheet*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :5/27/04; 10/2/06; 11/2/06; 11/8/07; 11/6/07.

DETAILED ACTION

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claim 59 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The specification discloses that a computer-readable medium may include the use of carrier waves. Carrier waves are not statutory subject matter.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 30-60 are rejected under 35 U.S.C. 102(e) as being anticipated by Chandrasekaran (U.S. 6,948,044).

As per claim 30, Chandrasekaran teaches a method for dynamically updating a virtual volume in a multi-tier virtualization storage system including a set of storage devices storing

virtual volume data and connected to a first set of storage processors, and a second set of storage processors connected to a host system associated with the virtual volume, wherein the virtual volume is defined by a set of virtual volume objects associated with selected ones of the first and second set storage processors, the method comprising: receiving a request from the host system to adjust the virtual volume data (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56); determining which virtual volume objects are affected by the request to adjust the virtual volume data (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56); updating the virtual volume based on the affected virtual volume objects and host system request; and allowing the host system to access the updated virtual volume (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 31, Chandrasekaran teaches the method of claim 30, wherein updating the virtual volume includes: updating a logical tree reflecting relationships between the virtual volume objects based on the request to adjust the virtual volume data (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 32, Chandrasekaran teaches the method of claim 31, wherein the virtual volume objects include first tier and second tier objects and wherein updating the virtual volume further includes: assigning first tier objects to selective ones of the first set of storage processors and second tier objects to selective ones of the second set of storage processors based on the updated logical tree (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 33, Chandrasekaran teaches the method of claim 31, wherein updating the logical tree includes: updating a definition for at least one of the virtual volume objects based on the host system request (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 34, Chandrasekaran teaches the method of claim 32, wherein the first tier objects include references to virtual volume data partitioned in the storage devices (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 35, Chandrasekaran teaches the method of claim 32, wherein the second tier objects include information reflecting a logical configuration of the virtual volume (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 36, Chandrasekaran teaches the method of claim 35, wherein the second tier objects includes references to selective ones of the first tier objects based on the logical configuration (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 37, Chandrasekaran teaches the method of claim 30, wherein updating the virtual volume includes at least one of adding a virtual volume object to a storage processor, removing a virtual volume object from a storage processor, and moving a virtual volume object from one storage processor to another storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 38, Chandrasekaran teaches the method of claim 30, wherein the virtual volume objects include first tier and second tier objects and updating the virtual volume includes restructuring a logical tree reflecting relationships between the second tier and first tier objects of

the virtual volume (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 39, Chandrasekaran teaches the method of claim 37, wherein the virtual volume objects include first tier and second tier objects and wherein adding a virtual volume object includes: adding a new second tier object to a target storage processor maintaining a first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 40, Chandrasekaran teaches the method of claim 39, wherein adding the new second tier object includes: configuring the new second tier object to include a Local Reference Node (LRN) that references the first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 41, Chandrasekaran teaches the method of claim 40, wherein configuring the new second tier object includes configuring the new second tier object with a Remote Reference Node (RRN) that references another first tier object maintained by a storage processor different from the target storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 42, Chandrasekaran teaches the method of claim 37, wherein the virtual volume objects include first tier and second tier objects and wherein adding a virtual volume object includes: adding a new first tier object to a target storage processor maintaining a second tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 43, Chandrasekaran teaches the method of claim 42, wherein adding the new first tier object includes: configuring the second tier object to include a Local Reference Node (LRN) that references the new first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 44, Chandrasekaran teaches the method of claim 37, wherein the virtual volume objects include first tier and second tier objects and wherein adding a virtual volume object includes: adding to a target storage processor a new first tier object that is logically related to a second tier object maintained in a different storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 45, Chandrasekaran teaches the method of claim 44, wherein adding the new first tier object includes: configuring the second tier object to include a Remote Reference Node (RRN) that references the new first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 46, Chandrasekaran teaches the method of claim 37, wherein the virtual volume objects include first tier and second tier objects and at least one existing second tier object tree including some of the second tier objects, and wherein removing a virtual volume object includes: removing the existing second tier object tree from a target storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 47, Chandrasekaran teaches the method of claim 46, wherein removing the existing second tier object tree includes: deleting all second tier objects in the second tier tree before deleting any first tier objects that are solely referenced by the removed second tier object

tree (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 48, Chandrasekaran teaches the method of claim 47, wherein the target storage processor maintains an existing first tier object referenced by the existing second tier object tree and by a remote second tier object maintained by a remote storage processor, and wherein removing the existing second tier object tree includes: maintaining the existing first tier object when deleting the second tier objects from the existing second tier object tree (column 3, lines 3-66; column 4, lines 1-56).

As per claim 49, Chandrasekaran teaches the method of claim 37, wherein the virtual volume objects include first tier and second tier objects and at least one existing second tier object tree including some of the second tier objects, and wherein removing a virtual volume object includes: removing an existing first tier object from a target storage processor (column 3, lines 3-66; column 4, lines 1-56).

As per claim 50, Chandrasekaran teaches the method of claim 49, wherein removing the existing first tier object includes: deleting all references to the existing first tier object from any second tier objects (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 51, Chandrasekaran teaches the method of claim 37, wherein the virtual volume objects include first tier and second tier objects and at least one existing second tier object tree including some of the second tier objects, and wherein moving a virtual volume object includes: moving an existing first tier object from a first storage processor to a second

storage processor having a remote reference to the existing first tier object (column 3, lines 3-66; column 4, lines 1-56).

As per claim 52, Chandrasekaran teaches the method of claim 51, wherein moving the existing first tier object includes: sending a new second tier object tree to the first and second storage processors that remove any references to the existing first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 53, Chandrasekaran teaches the method of claim 52, wherein moving the existing first tier object includes: sending a new first tier object to the second storage processor that deletes the remote reference to the existing first tier object from the second storage processor (column 3, lines 3-66; column 4, lines 1-56).

As per claim 54, Chandrasekaran teaches the method of claim 53, further including: sending a copy of the existing first tier object to the second processor following deletion of the remote reference (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 55, Chandrasekaran teaches the method of claim 54, further including: sending another second tier object tree to the second storage processor having a new local reference to the copy of the existing first tier object (column 3, lines 3-66; column 4, lines 1-56).

As per claim 56, Chandrasekaran teaches the method of claim 55, further including: sending the another second tier object tree to a third storage processor with a remote reference to the copy of the existing first tier object sent to the second storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 57, Chandrasekaran teaches the method of claim 31, wherein determining includes: sending the updated logical tree to a designated storage processor and receiving information from the designated storage processor indicating which virtual volume objects are affected by the request to adjust the virtual volume data (column 3, lines 3-66; column 4, lines 1-56).

As per claim 58, Chandrasekaran teaches the method of claim 57, further comprising: reassigning the virtual volume objects to selected ones of the first and second set storage processors based on the information received from the designated storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

Claims 59 and 60 are rejected on the same bases as claim 30, as the instant claims disclose limitations similar to claim 30.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chandrasekaran (U.S. 6,948,044).

As per claim 1, Chandrasekaran teaches a system for dynamically configuring a virtual volume associated with a host system, comprising: a set of storage devices, each of which

includes physical block addresses that store data associated with the virtual volume (column 3, lines 8-66); and a network switch system connecting the host system and the set of storage devices, and including: a set of storage processors each maintaining virtual volume objects including at least one of (i) first tier objects reflecting a relationship between the physical block addresses and one or more logical partitions of virtual volume data, and (ii) second tier objects reflecting a logical configuration of the virtual volume (column 4, lines 1-56). Chandrasekaran uses the virtual volume objects to manage the virtual volume (column 4, lines 1-56), but does per se teach that they are used to update the volume during runtime. In view of the Chandrasekaran system's managing of the virtual volume, it would have been obvious to one of ordinary skill in the art at the time of the invention to include the ability to update the system during runtime, as updating volumes is a well known component of volume management. Given that Chandrasekaran teaches other management aspects of the volume, it would have been obvious to include updating specifically.

As per claim 2, Chandrasekaran teaches the system of claim 1, wherein the network switch system dynamically updates the virtual volume based on a host system request (column 5, lines 3-66).

As per claim 3, Chandrasekaran teaches the system of claim 1, wherein the network switch system dynamically updates the virtual volume by at least one of adding a virtual volume object to a storage processor, removing a virtual volume object from a storage processor, and moving a virtual volume object from one storage processor to another storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 4, Chandrasekaran teaches the system of claim 1, wherein storage processors having a first tier object are connected to a storage device storing virtual volume data and storage processors having a second tier object are connected to the host system (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 5, Chandrasekaran teaches the system of claim 1, wherein the network switch system includes a Virtualization Block Manager (VBM) component that, based on a host system request, restructures a logical tree reflecting relationships between the second tier and first tier objects of the virtual volume (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 6, Chandrasekaran teaches the system of claim 5, wherein the network switch system further includes a Virtualization Coherency Manager (VCM) that assigns the first tier objects to selective ones of the storage processors and the second tier objects to selective ones of the second tier storage processors based on the restructured logical tree (column 3, lines 3-66; column 4, lines 1-56).

As per claim 7, Chandrasekaran teaches the system of claim 5, wherein when the host system request requires the VBM component to add a new second tier object to a target storage processor maintaining a first tier object, the VBM component configures the new second tier object to include a Local Reference Node (LRN) that references the first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 8, Chandrasekaran teaches the system of claim 7, wherein the VBM component configures the second tier object to include a Remote Reference Node (RRN) that references another first tier object maintained by a storage processor different from the target storage processor (column 3, lines 3-66; column 4, lines 1-56).

As per claim 9, Chandrasekaran teaches the system of claim 5, wherein when the host system request requires the VBM component to add a new first tier object to a target storage processor maintaining a second tier object, the VBM component configures the second tier object to include a Local Reference Node (LRN) that references the new first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 10, Chandrasekaran teaches the system of claim 5, wherein when the host system request requires the VBM component to add to a target storage processor a new first tier object that is logically related to a second tier object maintained in a different storage processor, the VBM component configures the second tier object to include a Remote Reference Node (RRN) that references the new first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 11, Chandrasekaran teaches the system of claim 6, wherein when the host system request requires the VBM component to remove an existing second tier object tree from a target storage processor, the VCM deletes all second tier objects in the second tier tree before deleting any first tier objects that are solely referenced by the removed second tier object tree (column 3, lines 3-66; column 4, lines 1-56).

As per claim 12, Chandrasekaran teaches the system of claim 11, wherein the target storage processor maintains an existing first tier object referenced by the existing second tier object tree and by a remote second tier object maintained by a remote storage processor, and wherein the VCM maintains the existing first tier object when deleting the existing second tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66; column 3, lines 3-66; column 4, lines 1-56).

As per claim 13, Chandrasekaran teaches the system of claim 6, wherein when the host system request requires the VBM component to remove an existing first tier object from a target storage processor, the VCM deletes all references to the existing first tier object from any second tier objects (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 14, Chandrasekaran teaches the system of claim 6, wherein when the host system request requires the VBM component to move an existing first tier object from a first storage processor to a second storage processor having a remote reference to the existing first tier object, the VCM sends a new second tier object tree to the first and second storage processors that removes any references to the existing first tier object (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 15, Chandrasekaran teaches the system of claim 14, wherein the VCM sends a new first tier object to the second storage processor that deletes the remote reference to the existing first tier object from the second storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 16, Chandrasekaran teaches the system of claim 15, wherein the VCM sends a copy of the existing first tier object to the second processor following deletion of the remote reference (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 17, Chandrasekaran teaches the system of claim 16, wherein the VCM sends a new second tier object tree to the second storage processor having a new local reference to the copy of the existing first tier object (column 3, lines 3-66; column 4, lines 1-56).

As per claim 18, Chandrasekaran teaches the system of claim 17, wherein the VCM sends the new second tier object tree to a third storage processor with a remote reference to the copy of

the existing first tier object sent to the second storage processor (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 19, Chandrasekaran teaches the system of claim 2, wherein the network switch system dynamically updates the virtual volume by collecting state information from the storage processors reflecting a current view of the virtual volume and reconfiguring a logical tree reflecting a logical relationship between the virtual volume objects based on the state information and the host system request (column 3, lines 3-66; column 4, lines 1-56).

As per claim 20, Chandrasekaran teaches the system of claim 19, wherein the current view of the virtual volume includes information reflecting which storage processors maintain first tier objects and which storage processors maintain second tier objects (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 21, Chandrasekaran teaches the system of claim 1, wherein each storage processor includes a virtualization state manager (VSM) that is configured to manage a local version of the virtual volume (Figure 9; column 1, lines 35-67; column 5, lines 3-66).

As per claim 22, Chandrasekaran teaches the system of claim 22, wherein each storage processor VSM is configured to manage any of the virtual volume objects maintained by the respective storage processor (column 3, lines 3-66; column 4, lines 1-56).

As per claim 23, Chandrasekaran teaches the system of claim 6, wherein a single storage processor includes a Master VSM (MVSM) that is in an active state (column 3, lines 3-66; column 4, lines 1-56).

As per claim 24, Chandrasekaran teaches the system of claim 23, wherein the MVSM is configured to determine which virtual volume objects are affected by the restructured logical tree (column 3, lines 3-66; column 4, lines 1-56).

As per claim 25, Chandrasekaran teaches the system of claim 24, wherein the VCM assigns the first and second tie objects to respective first and second tier storage processors based on the affected virtual volume objects determined by the MVSM (column 3, lines 3-66; column 4, lines 1-56).

As per claim 26, Chandrasekaran teaches the system of claim 23, wherein the network switch system designates the single storage processor as a Master Virtualization Storage Processor (MVSP) by activating the MVSM in the designated MVSP (column 3, lines 3-66; column 4, lines 1-56).

As per claim 27, Chandrasekaran teaches the system of claim 26, wherein non-MVSP storage processors include an MVSM that in an inactive state when the single storage processor is designated as the MVSP (column 3, lines 3-66; column 4, lines 1-56).

As per claim 28, Chandrasekaran teaches the system of claim 2, wherein the network switch system includes a Virtualization Coherency Manager (VCM) that updates virtual volume assignments to the storage processors based on the host system request (column 3, lines 3-66; column 4, lines 1-56).

As per claim 29, Chandrasekaran teaches the system of claim 28, wherein the network switch system includes a Virtualization Block Manager (VBM) that creates the first and second tier objects based on a user request to update the virtual volume (column 3, lines 3-66; column 4, lines 1-56).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tanim Hossain whose telephone number is (571)272-3881. The examiner can normally be reached on 8:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jason Cardone can be reached on 571/272-3933. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Tanim Hossain
Patent Examiner
Art Unit 2145

JASON CARDONE
SUPERVISORY PATENT EXAMINER